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THE NATIONAL DIOXIN AIR MONITORING NETWORK (NDAMN): RESULTS OF THE FIRST YEAR OF ATMOSPHERIC MEASUREMENTS OF CDDs, CDFs AND DIOXIN-LIKE PCBs IN RURAL AND AGRICULTURAL AREAS OF THE UNITED STATES: JUNE 1998 – JUNE 1999

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Introduction

The U.S. EPA has established a National Dioxin Air Monitoring Network (NDAMN) to determine the temporal and geographical variability of atmospheric CDDs, CDFs and dioxin-like PCBs at rural locations throughout the United States. Consisting of 29 sampling stations (Figure 1), NDAMN has three primary purposes: (1) To provide measurements of background atmospheric levels of dioxin-like compounds in different geographic regions of the U.S.; (2) To determine the atmospheric levels of dioxin-like compounds in agricultural areas where livestock, poultry and animal feed crops are grown; and (3) To provide data to evaluate results from long-range transport and deposition air models. NDAMN has been implemented in phases, with the first phase consisting of 9 monitoring stations. The following is intended to report the air monitoring results of the first phase of NDAMN which operated from June 1998 to June 1999.

Methods

In 1997, USEPA developed and designed NDAMN based on the following criteria: (1) NDAMN must provide reasonable geographical coverage of the continental U.S.; and (2) whenever possible, NDAMN sites are to be located in rural and other non-impacted areas. To enhance cost savings,

many of the sites were co-located at pre-existing air monitoring network stations located in rural areas. Twenty-nine stations were selected using these criteria (Figure 1). Due to the complexity in operation, and resource constraints, NDAMN is being implemented in phases. Phase 1 consists of an array of 10 monitors at 9 sites, which are identified as stations 1-10 on Figure 1. A duplicate sampler (station 2) is colocated at site 1. Each station consists of a PS-1 PUF sampler.[1] The sampling medium has two components: a quartz fiber filter (QFF) to collect and retain particulate matter (≥0.1 microns); and a polyurethane foam plug (PUF) to collect and retain gaseous phase compounds. In order to achieve a target 0.1 fg m^{-3} level of detection (LOD) necessary to avoid non-detects in air, the sampling moment was 24 days of sampling over a 28-day period, on a weekly schedule of 6 days of continuous operation followed by one day of inactivity. Each week, on the day the sampler was inactive, the QFF was harvested, yielding 4 composite samples per sampling moment. The PUF was harvested once at the end of the sampling moment. Strict QA/QC procedures are described in the Quality Assurance Project Plan.[2] Sampling proceeded with a regime of sampling 24 days, every other month. This produced 6 sampling moments over the year: (1) 6/23/98 – 7/21/98; (2) 8/18/98 – 9/15/98; (3) 11/24/98 –12/22/98; (4) 1/26/99 – 2/23/99; (5) 3/23/99 – 4/20/99; and (6) 5/18/99 – 6/15/99. This approach encompasses, for each sampling location, a broad range of meteological conditions. Samples were shipped to EPA's Environmental Chemistry Laboratory for extraction, clean-up and analysis with HRGC/HRMS in accordance with EPA Method 1613.[3] The analytes of interest in this monitoring program are the CDDs, CDFs substituted in the 2,3,7,8 positions on the molecule, and the so-called coplanar PCBs (IUPAC PCB-77; PCB-105; PCB-118; PCB-126; PCB-156; PCB-157 and PCB-169).

Results

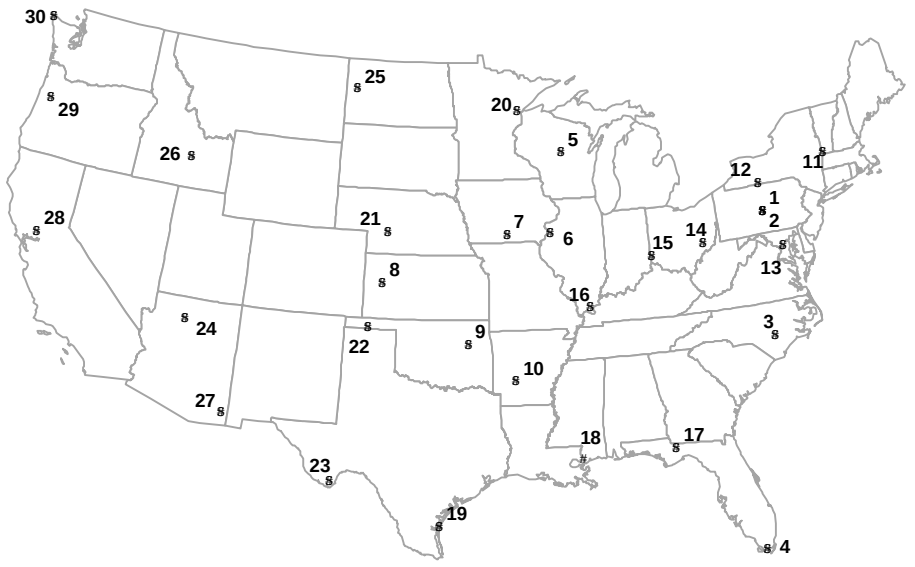
The following are the results of the first year of operation of NDAMN at 9 monitoring stations in the U.S. These are considered interim results; data interpretation may change in the future as data are collected over a longer time scale from all 29 sites in the network.

1. The overall annual average TEQ_{df}–WHO_{98} air concentration of CDDs, CDFs measured at nine rural stations is 12 fg m^{-3}. Other studies of rural areas of the U.S. found the following TEQ_{df}–WHO_{98} air concentrations: Ohio[4]: 22 fg m^{-3}; a mountain in Connecticut[5]: 10 fg m^3.
2. All congeners were detected in ambient air at a frequency >95% in rural locations.
3. There was a 6-fold range in TEQ_{df}–WHO_{98} annual average air concentrations from the lowest to the highest: 4.2 fg m^{-3} (station 8, Figure 1), and 25.4 fg m^{-3} (station 6). Figure 2 summarizes the annual average TEQ_{df}–WHO_{98} for all the 9 NDAMN stations.
4. Figure 3 displays the variability of TEQ_{df}–WHO_{98} over 6 monitoring moments at the 9 stations. The data indicate a significant increase in TEQ_{df}–WHO_{98} across all stations during the November/December monitoring moment. The TEQ_{df}–WHO_{98} rises by up to 9-fold over the other moments of the year. The increase in TEQ is characterized by a large increase in 1,2,3,7,8-PeCDD and an increase in 2,3,7,8-TCDD. Lohmann *et al.*[6] found a similar seasonal pattern in air monitoring in the U.K. and attributed it to seasonal changes in the predominant air mass movement carrying concentrated D/F from urban into rural areas. For the other sampling moments, TEQ_{df}–WHO_{98} varies from 2 to 17 fg m^{-3}, with the exception of station 6 (Monmouth, IL) and station 7 (McNay, IA), which remained elevated through March/April, 1999. The largest relative change (measured as the ratio of the winter concentrations to those of the prior sampling moment) occurs at station 8 (Lake Scott, KS.)
5. The PCB TEQ (WHO98) is small compared to D/F (range: 0.2 – 1.3 fg m^{-3}; mean: 0.7 fg m^{-3}). This comparison is displayed on Figure 2.

References

1. USEPA (1997). Compendium Method TO9a. EPA/625/R-96/010b.
2. USEPA (1998). Quality Assurance Plan and Work Plan, DEI: National Dioxin Air Monitoring Network. Versar, Inc. under EPA Contract 68-D5-0051.
3. USEPA (1995). EPA 821-B-94-005.
4. State of Ohio EPA (1995). Dioxin Monitoring Study 1995. September 1995.
5. State of Connecticut Dept. of Environmental Protection (1995). Ambient monitoring for PCDDs/PCDFs in Connecticut – fall 1993 – summer 1994. Doc. # 6350008500R1. Sept.
6. Lohmann, R., Green, N.J.L., Jones, K. C. (1999). Environ. Sci. Technol. 33:4440-4447.

FIGURE 1. Locations of NDAMN Stations



1. Penn Nursery, Potters Mill, PA
2. Penn Nursery, Potters Mill, PA (intercomparison)
3. Clinton Crops Research Center, Clinton, NC
4. Everglades NP, Florida City, FL
5. Lake Dubay, Dancy, WI
6. NW Ill. Agric. Res. and Demo. Farm, Monmouth, IL
7. McNay Research Center, Chariton, IA
8. Lake Scott State Park, Scott City, KS
9. Bixby Water Treatment Plant, Bixby, OK
10. Arkadelphia NADP, Arkadelphia, AR
11. Bennington NADP, Bennington, VT
12. Jasper NADP, Jasper, NY
13. Natl. Agric. Research Center (USDA), Beltsville, MD
14. Caldwell NADP, Caldwell, OH
15. Oxford NADP, Oxford, OH
16. Dixon Springs Agricultural Center, Pope Co., IL
17. Quincy NADP, Gadsden Co., FL
18. John C. Stennis Space Center, Bay Saint Louis, MS
19. Padre Island NS, Kleberg Co., TX
20. Fond Du Lac NADP, Carlton Co., MN
21. North Platte Agric. Exp. Station, Lincoln Co., NE
22. Goodwell Research Station, Texas Co., OK
23. Big Bend NP, Brewster Co., TX
24. Grand Canyon NP, Coconino Co., AZ
25. Theodore Roosevelt NP, McKenzie Co., ND
26. Craters of the Moon NM, Butte Co., ID
27. Chiricahua NM, Cochise Co., AZ
28. UC Davis Dairy Research Facility, Davis, CA
29. Hyslop Farm NADP, Benton Co., OR
30. Ozette Lake, Olympic NP, Ozette, WA

Figure 2. Annual Average Air Concentrations at 9 NDAMN Sites (femtogram per cu. m)

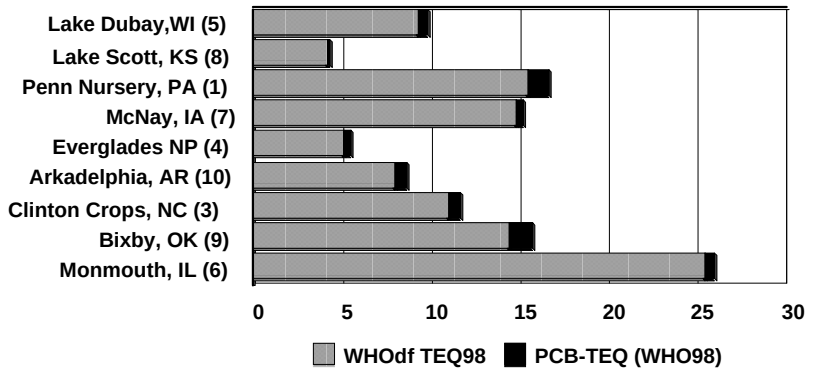


Figure 3. Seasonal WHOdf TEQ (fg/m3)